Space Weather Technical Forecast

Issued on Monday, 09 May 2022 at 13:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1 later UTC day of Tuesday. Chance of R1/R2 radio blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been, with isolated C-class flares. The largest of these flares was a C8.2 at 08/1938UTC from a region on the southeastern limb, currently designated as three spots. No Earth-bound ejecta is expected. There are currently seven sunspots on the visible disc. The three spots in the western hemisphere are simplifying as they approach the western limb and are becoming increasingly hard to analyse. In the eastern hemisphere, AR3006 retained its delta complexity, now with small and symmetrical penumbra and an increase in intermediate spots. The spot groups close to the southeast limb appear to have one mature feature and two NEW regions, a complex Dai and a Bxo. The magnetic complexity of both spot groups remains difficult to analyse at present due to foreshortening. There remain many long chain filaments at present on the disk.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, followed a slow regime, with the speed varying marginally between 350-290km/s. The solar wind density was similarly unremarkable in low single-figures ppcc. Meanwhile the IMF was weak yet a little erratic, with a peak of 8nT, and a north-south range of +6/-7nT. The phi angle was mostly negative (towards the Sun), until 09/0900UTC when it became mostly postive (away from the Sun). Resulting geomagnetic activity was mainly Quiet, but with a single peak Kp of 3 recorded at the 03-06UTC interval on 9th May.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours.

The high energy electron flux has varied between Weak to briefly High levels, reaching a peak of 1100pfu at 08/1610UTC. Electron fluence showed a gradual decline, with the 24-hour integrated observed value at 09/0001UTC being 2.7e7pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low to Moderate, as although some of the more potent recent spots are quietening down and/or rotating off the disc, newly-arrived active regions in the southeast are bolstering the risk to a degree.

Solar Wind / Geomagnetic Activity: A CME spawned by a disappearing filament 06/1900UTC may give Minor Geomagnetic Storm G1 intervals later Tuesday 10 May and on into Wednesday (UTC days). No significant coronal holes feature in this forecast - in any case, the sole small feature CH80/+ will likely be coincident with the aforementioned CME and its effect therefore masked. Geomagnetic activity should otherwise be Quiet to start and end the four-day period in the prevailing slow solar wind regime, probably most reliably so on Monday 09 May.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is at Background levels, with a daily Slight Chance of S1 largely as a result of AR3004's position near the western limb.

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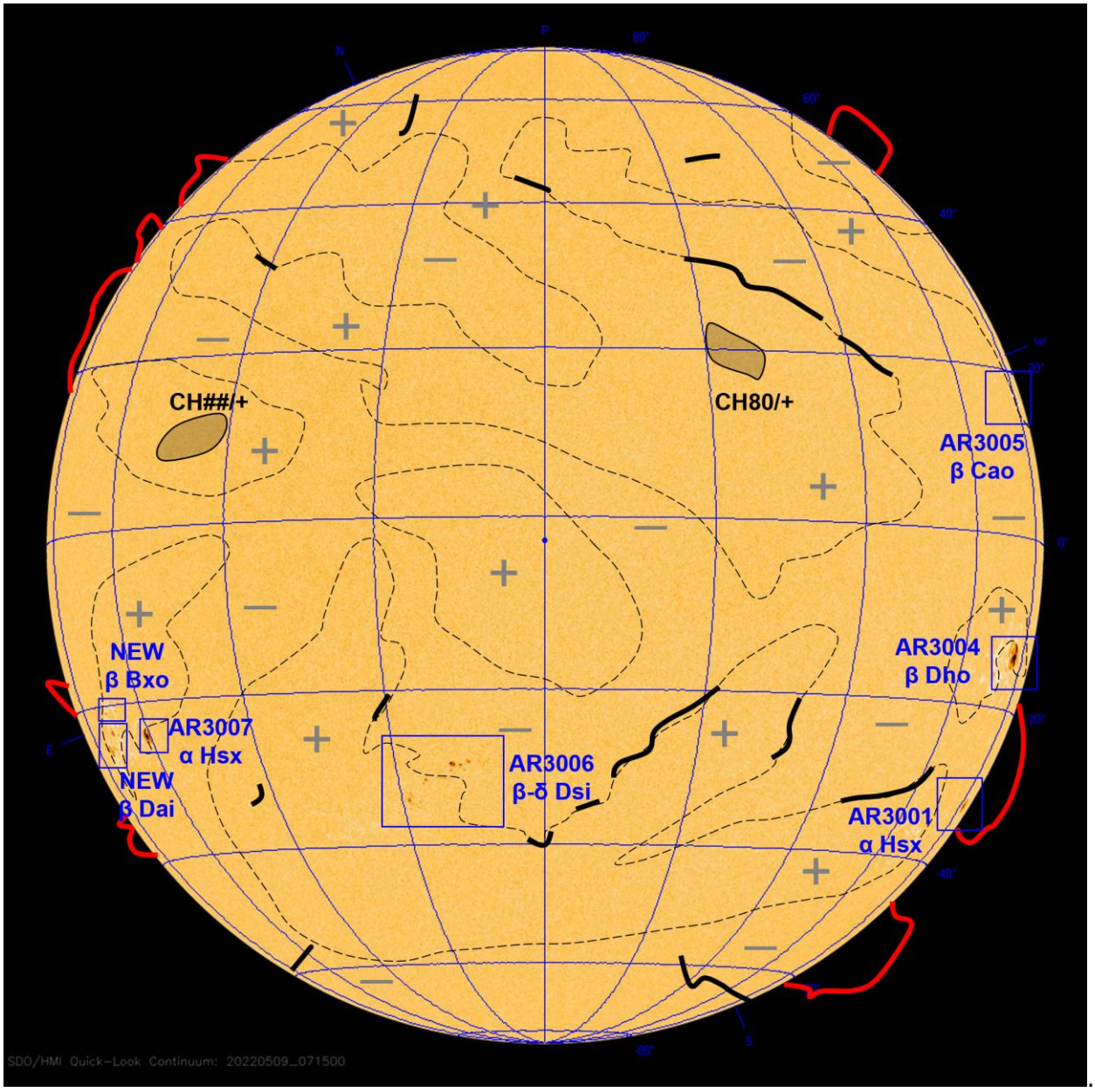
The high energy electron flux (greater than 2MeV) is forecast to remain at predominantly Weak to Moderate levels. A decline in the flux is expected through the four days, especially if geomagnetic activity increases with the 06/1900UTC CME arrival. 24-hour fluence is now Expected to remain below the Active threshold.

Figure 1. Solar Analysis Valid 09/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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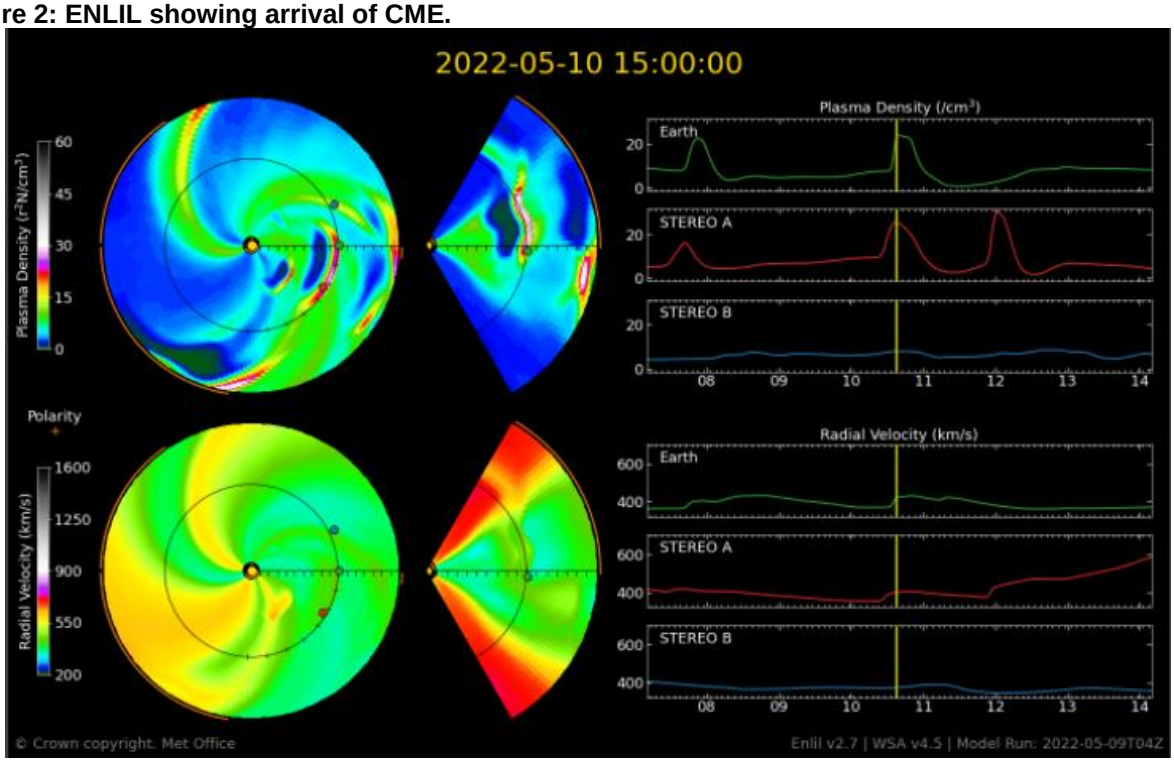
Geomagnetic Storms:

One CME features in the forecast period from a northeastern quadrant filament lift off that occurred 06/1900UTC.

There is one small non-persistent coronal hole on the disc at present that features in the forecast, CH80/+ in the northern solar hemisphere. Any Earth-based effect is likely to be around midweek UTC, however the impact is likely to be minimal, probably proving indistinct due to the anticipated CME arrival. MOSWOC Enlil currently assesses this feature as having an arrival time around mid-afternoon UTC on Tuesday 10 May, with effects then probably continuing into Wednesday 11 May. Slightly lowering confidence in this onset is the fact that MOSWOC Enlil has a quicker than expected intervening solar wind, with an enhancement from a persistent coronal hole that no longer exists. This means that the transit time to 1AU for the impending CME ought to be slower than suggested, and the risk of G1 is therefore roughly equally partitioned between Tuesday and Wednesday.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	30	20	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: ENLIL showing arrival of CME.



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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

There are currently seven sunspots on the visible disc. The three spots in the western hemisphere are approaching the western limb and are becoming increasingly hard to analyse and will all likely disappear within the next 24 hours, as reflected in the percentages. AR3004 shows continued decay of trailing spots, almost now a single feature. AR3005 retains its previous classification, although part of it's leader has rotated out of view, this will remain the same until the spot has rotate completely out of view. AR3001 remained a stable and unremarkable unipolar group.

In the eastern hemisphere, AR3006 remains a delta spot, now with small and symmetrical penumbra and an increase in intermediate spots numbers. AR3007 remains a simple unipolar spot. Following shortly behind near the southeast limb, there appears to be two new regions, a complex Dai and a Bxo several degrees closer to the equator. The magnetic complexity of both spot groups remains difficult to analyse at present due to foreshortening. These spots will become clearer in subsequent analyses, but at the present we look to this area and the many filaments across the disk for the most likely places for activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	20	20	20
Very Active	R3 to R5 X Class	No	5	3	3	3

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days.

There is a daily Slight Chance of S1, mainly due to AR3004's approach towards the western limb but also now AR3005. Despite this slight risk, it should be noted that none of the current disc have a history of producing any proton response at GOES16.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	2	5	5	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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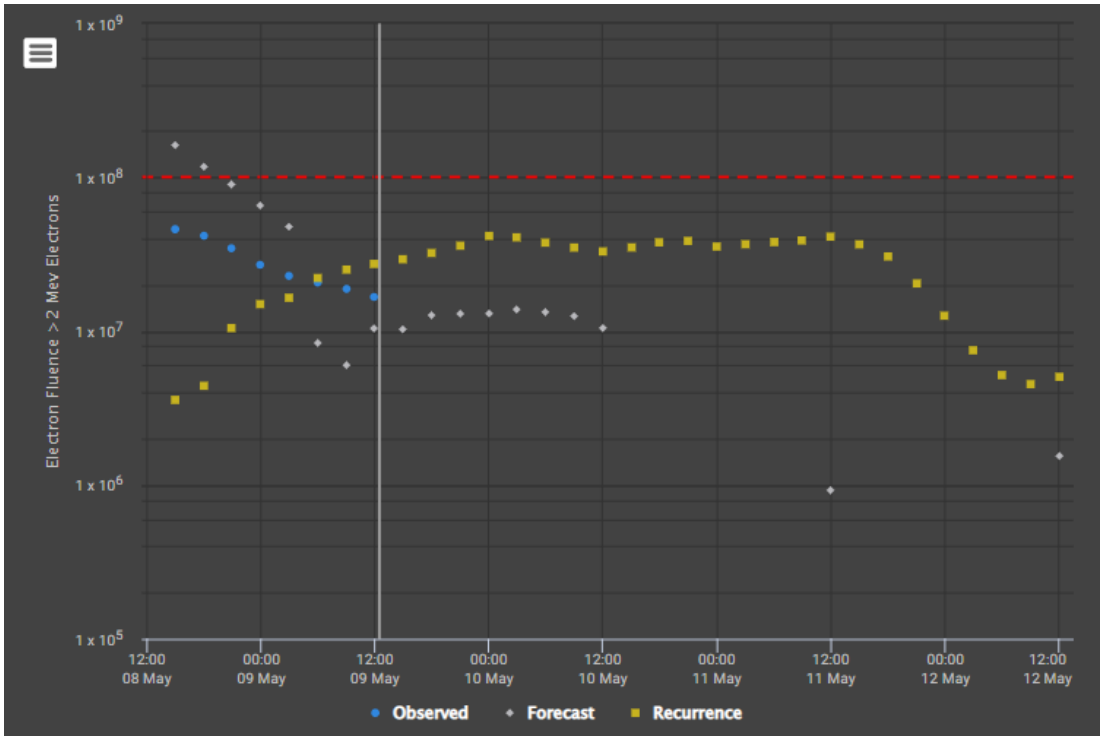
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is forecast to be mainly Weak to Moderate, perhaps with a slight chance of reaching High levels in its diurnal oscillation. A gradual decline in fluence is otherwise likely through the period in the unsupportive current solar wind environment.

The likelihood for Active fluence levels to be reached should reduce with time, especially with potential significant geomagnetic activity occurring in the wake of any CMEs. Output from MOSWOC REFM is therefore considered to be offering good guidance in keeping the fluence below the Active threshold, combined with a declining trend.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	5	5	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: REFM fluence observations and forecast.



NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.

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